

Patterns of Femoral Bone Remodeling and Age Determination: Comparison of the Tongariki Native Easter Islanders with European Population. AG DRUSINI, Dept. of Biology, University of Padova, Italy.

Histologic and histomorphometric analysis of femoral diaphyseal fragments (excluding the *linea aspera*) from twenty Precontact native Easter Islanders (9 males and 11 females) were compared with those of one hundred fifty one XIX century Europeans (81 males and 70 females) of known age, sex, occupation and cause of death. Thin undecalcified histological sections of approximately 90 microns embedded in ethylmetacrylate were obtained using a Leitz 1600 rotating microtome. The sections were examined under low power with 10X ocular and 10X widefield ocular lenses using a standard laboratory microscope with a grid of 0.64 mm² to the eyepiece. The following variables were studied: X₁=secondary osteons; X₂=type II osteons; X₃=fragments of old osteons; X₄=resorption spaces; X₅=non-haversian canals; X₆=average % unremodeled bone; X₇=average % osteonal bone; X₈=average % fragmental bone. A significant difference (P < 0.05) was found between Tongariki and XIX century Europeans osteon population densities: the osteon population density of Easter Islanders is nearly double compared to the European sample. It is not possible to determine whether the histological differences were the products of biomechanical strains, but it is clear that bone turnover in the Tongariki population was different relative to Europeans. This study also applies a recently formulated method of histologic estimation of age at death and compares the results with age estimates made by M.F. Erickson (1991). The two methods produced two different overall paleodemographic pictures of the same populations.

Timeless Tomb: Stable Carbon Evidence for Tomb Reuse in the Dakhleh Oasis, Egypt. T.L. DUPRAS, Dept of Soc & Anth, U of Central Florida, Orlando, FL 32816-1360; S.I. FAIRGRIEVE, Anthro Program and Dept of Biology, Laurentian University, Sudbury, Ontario PE3 2C6 Canada; H.P. SCHWARCZ, School of Geography and Geology, McMaster University, Hamilton, Ontario L8S 4L9 Canada; J.E. MOLTO, Dept. of Anthropology, Lakehead University, Thunder Bay, Ontario, P7B 5E1 Canada

The reuse or continual familial use of tombs in Egypt has been well documented. During the Pharaonic period, individuals from the ruling class were known to have reused the tombs of their predecessors. It was also common for tombs to contain several generations of a particular genetic lineage.

The Dakhleh Oasis, located approximately 450 miles southwest of Cairo, has several cemeteries that contain tomb structures with multiple interments. The undisturbed Chamber 1 of Tomb DK-31 in the cemetery of 'ein Tirghi contains 22 individuals which were interred in four distinct

layers. Carbon dates from two individuals from the oldest or bottom layer indicate that the tomb was being used as early 800 BC (Third Intermediate).

Stable carbon isotope data from individuals (N=18) in the tomb reveal an interesting pattern. The individuals interred in the top, or youngest layer show carbon isotope signatures that are markedly enriched in ¹³C compared to individuals from the bottom most layers. This enrichment signals a change in diet from the Third Intermediate Period to the time when the last individuals were interred. Isotope analysis and botanical remains from the neighboring ancient village site of Kellis show that millet, a C₄ plant that is enriched in ¹³C, was present in the Oasis only after the beginning of the Roman Period (ca. AD 100). The carbon isotope signatures of individuals from the top layer may be the result of the direct consumption of millet or indirectly through the consumption of animal products that were fed a diet of millet. Before this time the diet of the inhabitants consisted of C₃ foods. As such, the isotopic signatures from individuals in this tomb suggest that the tomb was either in continual use for at least 1000 years, or, more likely, that the tomb was reused in later time periods. Pending ¹⁴C dates and DNA analysis of individuals in the younger, top layers will shed further light on this question.

Does bifidity of cervical spinous processes increase with age? S.M. DURAY, Department of Anatomy/Pathology, Palmer College of Chiropractic, 1000 Brady Street, Davenport, Iowa 52803.

In a previous study (Duray et al., 1999), significant differences in the frequency of bifidity of cervical spinous processes were found in a skeletal sample of 359 Americans of African (black) and European (white) descent. At C3-C6, whites showed a significantly higher frequency of bifid spinous processes than blacks. Logistic regression analysis revealed C3 and C4 to be the most useful levels for identifying race (ancestry). Based on these levels, 76.05% of a validation subsample was correctly classified (80.25% for whites, 72.09% for blacks).

One factor which could potentially affect the distribution of bifidity is age. The mean age for whites in the sample is 49 years, while that for blacks is 40 years. This difference is significant (p=.0001) based on the t-test. If bifidity reflects in part, an age-related, degenerative process, the age difference between the samples could partially explain the differences seen between blacks and whites. In the present study, the hypothesis is tested that bifidity increases with age within the study sample.

The sample consisted of the 359 individuals from the original study, selected from the Hamann-Todd collection. Age at death was derived from autopsy records. Statistical methods included independent sample t-tests and logistic regression. Analysis was restricted to the C3 and C4 levels. Age was compared for individuals with bifid versus nonbifid spinous processes at each vertebral level. Whites and blacks were analyzed separately. No significant differences in age were found at either level, for either race,

based on the t-test. The addition of age to the logistic regression model did not cause a decrease in odds ratios or significance for C3 and C4. Thus, bifidity/nonbifidity at these levels remain strong predictors of race when age is adjusted for. This study demonstrates that bifidity of cervical spinous processes is a robust, population-specific nonmetric trait which is not significantly affected by age-related degenerative changes.

The question of speciation in *Homo erectus* revisited II: the non-metric evidence. A.C. DURBAND and J.H. KIDDER, Department of Anthropology, University of Tennessee, Knoxville, TN 37996

The fossils currently subsumed within the taxon of *Homo erectus* continue to present a dilemma to paleoanthropologists despite a lengthy debate. The metric and morphological variation present in this sample is seen by some workers as evidence for speciation. Others regard *H. erectus* as a highly polytypic species whose variation is mirrored by that of our own species.

In the present study the non-metric evidence for speciation within *H. erectus* is considered. The most complete crania from Africa (ER 3733, ER 3883, OH 9, WT 15000), China (Zhoukoudian II, III, X, XI, XII) and Indonesia (Sangiran and Ngandong) are examined to test the hypothesis that a distinct pattern of regional variation is present in the fossil sample. Visual inspection of original specimens and casts is used to facilitate comparison of these crania using character traits derived from the literature. Several of these features, such as the lack of a styloid process and the presence of the tympano-mastoid fissure have been noted in earlier work on this subject, but other potentially informative features have been neglected. We are also aware that fossil sample time-depth can confound an analysis of this sort and we have made every effort to control for this variable.

In conjunction with our project studying the metrics of this sample, we find evidence of patterned variation that allows us to subdivide the fossils into separate groups. Most notably, the Ngandong specimens possess a number of features that are not found on any other hominid crania. Our results strongly suggest that multiple groups, and perhaps separate species, exist in the group of fossils currently attributed to *H. erectus*.

Primate enamel hypoplasias as indicators of metabolic stress, adaptation, and evolution. R. B. ECKHARDT, The Pennsylvania State University, University Park, PA 16802.

During tooth formation, the deposition of dental enamel is a developmental process that occurs along known pathways that are under genetic control but also subject to environmental constraints of various sorts.

Deposition of enamel is particularly sensitive to disruptions of metabolic processes by nutritional insufficiencies, infectious diseases or other systemic stresses that may have measurable associations with morbidity or mortality.

Dental enamel defects represent a category of phenomena that are of interest at three hierarchical levels: metabolic norms of reaction at the tissue level, developmental plasticity at the individual level, and genetic change at the population level when intragenerational buffering mechanisms prove insufficient. From the perspective of biological anthropology, these phenomena can be studied experimentally or observationally in several comparative contexts: extant humans, living nonhuman primates, and antecedents of both groups preserved in paleontological contexts.

From a uniformitarian standpoint, shared phenotypes (for example, enamel hypoplasias) in related organisms (extant and earlier populations of nonhuman and human primates) should be assessed in common inferential frameworks (stress markers provide clues to health and probability of survival). However, despite some notable positive exceptions (e.g. Tobias, 1967; White, 1968; Molnar & Molnar, 1985), enamel hypoplasia frequencies differing by less than 12% between samples have been interpreted as measures of the probability of survival at level of species taxa rather than at the level of individuals or local populations. Hypotheses that seek to relate causally the frequencies of stress markers in populations to evolutionary fates of species-level taxa should at least include evidence that the markers influence probabilities of survival or reproduction, as well as estimates of the extent to which such influences lead to outcomes in which the limits of developmental and genetic adaptability in comparable extant populations would be exceeded. A unified science of human biology that can address problems of adaptation in present and past populations must establish common rules of inference.

Comparative Human and Mammalian Taphonomy at the Richards site, Ohio. H.J.H. Edgar and T.S. Barette, Department of Anthropology, The Ohio State University, Columbus OH 43210.

The Richards Site is attributed to the Philo phase of the Fort Ancient tradition of the Ohio Valley. Human skeletal material from the site shows evidence of peri- and post-mortem taphonomic changes, including cut marks, burning, and fracturing. Previous analyses have discussed explanations for these changes, including secondary burial, ritual destruction, and cannibalism (Edgar 1998, Church, et al. n.d.).

The human remains at the Richards Site were disposed of in general middens, mixed cultural debris and faunal remains. White-tailed deer constitutes approximately sixty per cent of all the faunal bone, indicating that it was a major food resource. To test a cannibalism hypothesis, a comparative analysis of human-induced taphonomy in human and deer skeletal remains was performed. If humans were being used as a food resource, it is possible that the pattern of butchery would mirror that of the deer.

Observations were made on over 1,700 and

1,250 fragments of human and deer bone, respectively. Notation was made as to whether the fragment was epiphiseal or diaphiseal, and taphonomic markings were classified as cuts, burns, crush/chop marks, and greenstick fractures. Human long bones showed a pattern of having many cut marks and little burning, while the deer bone was frequently burned but showed relatively few cut marks. Greater than the expected number of epiphyses were found among the human remains, while fewer than expected were found among the deer remains. These results are different than would be expected the taphonomic changes observed resulted from cannibalistic activity.

Origins of population structure in modern humans. E.E. ELLER, Department of Anthropology, University of Utah, Salt Lake City, UT 84112.

Much of debate on origins of modern humans has focused on questions of regional continuity, genetic diversity and effective population size but ignored population structure. However, because the two primary competing models invoke different processes for how biological differences among contemporary human populations arose, the origins of population structure in modern humans is an important aspect of the debate. The Multiregional Evolution model (MRE) lends itself easily to modeling origins of differences among populations while the Recent African Origin model (RAO) traditionally has not incorporated it. Within the MRE framework a long timescale and differential gene flow among populations allowed differences among populations to accumulate. A major problem with MRE from a population genetics perspective is the lack of genetic diversity in modern humans. MRE seemingly requires a large effective population size for populations to occupy the Old World, but the effective population size and thus genetic diversity could be reduced if a largescale population bottleneck occurred during the Pleistocene or if human populations habitually underwent a process of extinction and recolonization events.

In contrast, RAO assumes a small effective population size and thus low genetic diversity among modern humans. Two variations to RAO that incorporate population structure have been proposed. The Divided Eden model hypothesizes that the human species was subdivided before undergoing a population expansion in the late Pleistocene. The Babel model proposes that differences among populations originated as colonizing populations budded from a parent population and underwent founder effects.

I performed computer simulations based on Hudson's (1990) coalescent algorithm to model various demographic histories based on the models described above and report basic statistics including genetic diversity and amount of population structure. I then compared the simulated data to four existing multilocus data sets: two short tandem repeat and two restriction site polymorphism data sets. Preliminary results suggest that while the MRE model can easily predict existing degrees of contemporary population structure, genetic diversity is too high unless rather unrealistic assumptions about effective population size are made. Simulations of more complex MRE scenarios are necessary. Simulations of the two RAO-inspired models, Divided Eden and Babel, suggest that these models can result in contemporary levels of both genetic diversity and population structure. However, these two types of models are difficult to distinguish, and the existing data do not favor one over the other.

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Habitat preference and locomotion in Plio-Pleistocene *Theropithecus* species. S. Elton, Department of Anthropology, University of Kent at Canterbury, CT2 7NZ, UK.

The sole modern species of *Theropithecus*, *T. gelada*, is a highly terrestrial monkey that inhabits open grassland, and it is commonly argued that *T. oswaldi* had a similar habitat preference and locomotor strategy, on the grounds that the two species share a number of postcranial adaptations that relate to feeding method. However, another member of the genus, *T. brumpti*, thought to be much more arboreal, also possesses many of these traits. This demonstrates that different *Theropithecus* species can share similar dietary adaptations yet inhabit varied habitats.

In this study, ecomorphic techniques are used to examine the habitat preferences and locomotor strategies of fossil theropithecines. Metrical data reflecting limb bone shape and muscle lever arms were collected from fossil specimens, and also from a modern comparative sample comprising 12 species of African cercopithecoid. Each of the modern species was assigned to one of three habitat/locomotor categories (forest habitat arboreally locomoting, open habitat terrestrially locomoting, and open habitat mixed arboreally and terrestrially locomoting). Data from this modern sample were included in a series of discriminant function analyses that were used to assign the fossil postcranial specimens to the most likely habitat/locomotor category.

In line with other studies, *T. brumpti* was found to be predominantly arboreal. However, *T. oswaldi* specimens were consistently assigned to the open habitat mixed locomotion group rather than to the open habitat terrestrial locomotion category, demonstrating that they were more similar to modern *Papio* than to the gelada. This suggests that *T. oswaldi* used a mix of arboreal and terrestrial locomotion in a broadly open (non-forested) habitat, and may have used its environment in a way similar to early hominins.

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Upper Paleolithic transitions: adaptations to dynamic environments. J. G. ENLOE, Anthropology, University of Iowa, Iowa City, IA 52242

While the nature and timing are vigorously debated for a major transition at the beginning of the Upper Paleolithic, less attention has been paid to less dramatic changes at its end. This paper examines environmental and adaptive changes in the Paris Basin at the end of the Pleistocene. The Magdalenians of the late Upper Paleolithic are quite often viewed as specialized hunters. Sites in the Paris Basin with good faunal preservation, such as Pincevent IV-20 and Verberie, are dominated by reindeer and exhibit tightly focused seasonality. Other species are present, include horse, fox, ground squirrel, wolf, hare, mammoth, and birds. The role of those other species within an otherwise specialized subsistence system is examined, and compared to slightly later Tardiglacial sites, such as

Marolles and at Pincevent IV-0, in which horse remains equal or dominate those of reindeer. Changes in species dominance at Paris basin sites can be seen as strategic change in hunting in the region. Climatic change at the end of the Tardiglacial dictated a shift in the availability of prey and the fashion in which prey was processed. These adaptive changes can be seen in lithic technology, site structure and hearth use.

A research resource for comparative and evolutionary primate biology. J. ERWIN, P. HOF, P. GANNON, R. HOLLOWAY, and D. PERL. Division of Neurobiology and Behavior, Bioqual, Inc., Rockville, MD 20850-3336.

The Great Ape Aging Project: A Comparative Neurobiology of Aging Resource (J. Erwin, PI) has gathered more than 45 great ape brains ranging in age at death from one day to more than 58 years. These specimens, on loan from zoological gardens and research centers, have been made available for a variety of studies of brain morphology and neuroanatomy, including detailed stereologic quantification of specific cell populations. An example of work using these specimens reported the exclusive occurrence of large spindle cells in the anterior cingulate cortex of great apes and humans. These cells were not found in 24 species of non-great apes (gibbons, old world monkeys, new world monkeys, or prosimians). Stereologic techniques were also used to measure cell volumes. Volumes of spindle cells in humans and great apes were strongly correlated with indicators of encephalization. The Great Ape Aging Project has identified all the oldest great apes in American zoological gardens and research centers and is obtaining systematic behavioral observation, videorecordings of locomotor patterns, and in some cases, cognitive assessments. When possible, clinical chemistries, endocrine values, and other health records are obtained. Following natural death or euthanasia for humane reasons, brains and other tissue specimens are taken. These are archived for later study, and opportunities exist for development of collaborative use of the resource. Additional specimens from other species are now being collected and will also be made available for collaborative research. Funding was provided by a USPHS/NIH grant (AG14308) from the National Institute on Aging to Bioqual, Inc., J. Erwin, Principal Investigator.

The Genetic Prehistory of California's Central Valley. J. A. ESHLEMAN, Department of Anthropology, University of California-Davis, 95616.

The mitochondrial DNA of Native Americans contain polymorphisms

consisting of the gain or loss of restriction sites or the presence of a 9 base pair deletion. These mutations characterize at least five distinct haplogroups (maternal lineages). Modern Native American groups differ with respect to the frequency distribution of these five haplogroups.

Archaeological and linguistic evidence suggests that Hokan speaking inhabitants of the California Central Valley were replaced by a migration and expansion of Penutian speakers between 4500 to 5000yBP. Analysis of ancient DNA extracted from numerous skeletal populations from the Central Valley dating between 7400 and 700yBP have been used to investigate the hypothesized population replacement. The mtDNA obtained from these samples was compared to modern and ancient Native American mtDNA from California, the neighboring Great Basin, and the Columbia Plateau.

Micro-evolution of the bony nasopharynx in Sudanese Nubia. T.L. Estenson, University of New Mexico, Albuquerque, NM.

A number of researchers have described a consistent pattern of morphological change in the skulls of Holocene populations associated with the shift from foraging to agriculture. These modifications were particularly well-documented by Carlson [1974] and others in Sudanese Nubia. The *masticatory-functional hypothesis* [Carlson and Van Gerven 1977] posited that a softer diet decreased functional demands on the masticatory system effecting an overall gracilization of the skull. Concomitantly, cranial vaults decreased in length, increased in height and became more globular, mandibles and teeth decreased in size, and faces rotated posteroinferiorly resulting in a more orthognathic profile. Similar patterns of change have also been identified in populations in Europe and North American.

Working from lateral x-rays, Carlson showed that the rotation of the face brought about a closer anterior-posterior (AP) approximation of oro-nasal structures (palate, ramus) with the basi-occipital and cervical vertebra. Viewed from the lateral perspective, one consequence of this would have been an AP impingement of the airway, particularly of the nasopharynx. As previous research has shown that there is a correlation between metabolic oxygen

need and the size of the airway, such an impingement would compromise respiratory function unless airway volume was maintained by compensatory increases in other dimensions.

This study re-examined the same skeletal material Carlson analyzed and investigated the hypothesis that there was an offsetting increase in superior-inferior (SI) or medial-lateral (ML) nasopharyngeal dimensions which would have preserved airway volume. While SI measures decreased, ML measures (bi-medial pterygoid plate, bi-carotid) increased. Discussion will focus on respiratory function as a constraining force on cranial base morphology and the importance of three-dimensional analysis for understanding evolutionary change.

Selection and stress in a population of *Alouatta palliata*: Evidence from molar size and asymmetry. M. A. EVERETT, D. DEGUSTA, Dept. of Integrative Biology, and K. V. MILTON, Dept. of ESPM, University of California, Berkeley, CA 94720.

Dental morphology is generally held to be under selection, yet this has rarely been tested empirically. Using a large collection (n=183) of howler monkey (*Alouatta palliata*) skulls from Barro Colorado Island (BCI), Panama, we tested whether molar crown size was related to age at death. Since all the individuals in our sample were found dead of natural causes, their age at death is a rough indicator of fitness. The skulls were divided into four general age categories (2--5, from youngest to adult) based on tooth eruption. The youngest individuals in the sample (age stage 2, ~6--12 months old) have significantly smaller permanent first molars than the other age stages.

Developmental stress is usually assumed to decrease fitness, but this has rarely been tested in natural populations. Fluctuating dental asymmetry (FDA) is widely (though not universally) considered to be an indicator of stress. We examined whether FDA was related to age of death in this sample. While there are notable methodological difficulties in quantifying FDA, it appears that age stage 2 howlers, relative to crown size, have an elevated rate of FDA compared to all other age stages.

Overall, then, BCI howlers with small molar crowns and high levels of asymmetry tend to die before ~1 year of age. Beyond that, crown size and FDA do not appear to relate to age at death in this population. This suggests an early selective bottleneck with important implications for howler life history strategies.

Analysis of femoral head trabecular architecture using μ CT: evidence from some anthropoids and lorisooids. R.J. FAJARDO, Doctoral Program in Anthropological Sciences, SUNY at Stony Brook, NY 11794, L.M. MacLATCHY, Department of Anthropology, Boston University, Boston, MA 02215, and R. MÜLLER, Orthopedic Biomechanics Laboratory, Beth Israel Deaconess Medical Center and Harvard Medical School, 330 Brookline Ave., Boston, MA 02215.

Biomechanical theory and experimental data indicate that cancellous bone is influenced by its loading environment. This suggests that architectural correlates of primate locomotor behavior should exist in cancellous bone. Rigorous quantitative treatments of primate trabecular architecture have been hindered by methodological factors including the scarcity of primate specimens that inhibits traditional histological examinations, the low-resolution images produced by planar radiographs and medical CT's, and the lack of automated analysis tools. Quantitative methods are needed to better evaluate the strength of the locomotor signal in nonhuman primate cancellous bone and determine its potential for the interpretation of fossils. Micro-computed tomography (μ CT) is a new approach to assess the three-dimensional architecture in detail. We present the results of a preliminary three-dimensional quantitative study of nonhuman primate cancellous bone.

The proximal femora of six taxa were scanned in this study: *Hylobates lar*, *Ateles paniscus*, *Macaca mulatta*, *Papio anubis*, *Galago senegalensis*, and *Perodicticus potto*. Bone cores were extracted from the anthropoid specimens due to size constraints of this specific scanner's gantry, but the lorisooid specimens were scanned whole. Scanner resolution was set to 34 μ m in all planes. After three-dimensional image reconstruction, morphometric parameters were measured.

Preliminary data indicate that density-related variables such as the bone volume fraction, trabecular thickness, trabecular separation, and trabecular number may not carry a strong locomotor signal. Instead, the degree of textural anisotropy does appear to differentiate primate locomotor groups. Climbing and suspensory locomotor modes appear to be associated with a relatively less organized trabecular arrangement than are more stereotypical modes, such as quadrupedalism and leaping. Few data exist on this type of skeletal variation in nonhuman primates. With the advent of μ CT, more data can be collected nondestructively to address the question of how well trabecular architecture reflects locomotor behavior. In addition, the application of these imaging and quantification methods to fossils might lead to another tool to interpret extinct primate locomotor behavior.

New sub-Saharan Oligocene fossil localities from northwestern Ethiopia. M. FESEHA¹, J. KAPPELMAN², D. T. RASMUSSEN³, J. FLEAGLE⁴, P. COPELAND⁵, T. RYAN², and W. SANDERS⁶ ¹Dept Geological Sciences, ²Dept Anthropology, Univ Texas, Austin, TX 78712-1086; ³Dept Anthropology, Washington Univ. St. Louis, MO 63130; ⁴Dept of Anatomical Sciences, SUNY, Stony Brook, NY 11794-8081; ⁵Dept Geosciences, Univ Houston, Houston, TX 77204-5503; ⁶Museum of Paleontology, Univ Michigan, Ann Arbor, MI 48109-1079

One of the most outstanding questions about Tertiary African faunal evolution concerns the tempo and mode of

the transition between the more archaic vertebrate faunas of the Oligocene and the more modernized faunas of the Miocene. The roughly 10 million year long period of time that separates the well-documented Oligocene faunas from those of the early Miocene witnessed a turnover that included the extinction of several mammalian families and the first occurrence of many others. The answer is complicated by the fact that there are no well-documented faunas known from within this long period of time.

In 1997 we began a survey of northwestern Ethiopia for Tertiary fossil localities. The site of Chilga, located north of Lake Tana, is well-known for its lacustrine sediments and lignites. Yemane et al. (1985, 1987) published a pollen and spore profile from a 34 m section which suggested a closed, humid but perhaps seasonal forest, and dated an underlying basalt at 8.0 ± 1.2 Ma. Our investigations show instead that this late Miocene basalt is in a downfaulted relationship to the sediments. A conformable section of over 130 m of sediments about 5 km to the south has a 32 ± 1.6 Ma basalt at its base. We have located 35 fossil localities that can be mapped into this section along with an associated tuff dated at 27.36 ± 0.11 Ma. The fauna includes *Arsinoitherium*, palaeomastodonts, cf. *Platybelodon*, deinotheres, hyracoids, rhinos, and anthracotheres, as well as plant remains. The late Oligocene Chilga fauna offers great potential for understanding the nature of the Oligo-Miocene faunal transition in Africa, as well as the timing of the origin of several extant primate families.

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Handedness in a primate species (*Cebus apella*). L. L. FIELDS, Department of Sociology and Anthropology, New Mexico State University, Las Cruces, NM 88003.

Handedness in non-human primate species has received much attention as our understanding of handedness in humans has progressed. Its implications are far-reaching, affecting subjects as varied as language development and tool use. Studies of handedness have been conducted on numerous species including orangutan, cotton-top tamarin, chimpanzee, gorilla, Japanese monkey, and capuchin monkey. Unfortunately, results have been varied and there is little definitive evidence of handedness in individuals or groups. In an effort to enhance understanding of handedness in monkeys, I observed eight members of a captive colony of the brown or tufted capuchin monkey, *Cebus apella*, for hand preference in gross and fine motor skills.

The monkeys were observed over a period of 12 weeks. Each monkey was observed for four hours at times distributed throughout the day. Hand preference was noted for each of the following behaviors: grooming, scratching, fur rubbing, reaching for food, objects, conspecifics, locomotion (jumping, walking, climbing, brachiating), eating, foraging, playing, holding objects, and using objects. Focal sampling techniques were used.

Preliminary analysis indicates that handedness is not clearly defined in these captive capuchin monkeys, although individuals appear to prefer one hand over the other for selected tasks.

Due to their manual dexterity, affectionate nature, intelligence, and level of ease in training, capuchin monkeys are ideal in aiding paraplegic individuals. As these monkeys are trained, it seems important that consideration be given to their hand preferences for selected tasks.

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Testosterone and dominance in Kibale red colobus males (*Colobus badius tephrosceles*). S. FIROS, Department of Anthropology, Yale University, New Haven, CT 06520.

Research on the relationship between testosterone level and male dominance rank in primates is important because of the potential influence of this hormone on fighting success. However, this relationship is not always straightforward; for example, high-ranking males exhibit higher testosterone levels than low-ranking males in some species, but not in others. Red colobus monkeys are valuable subjects for research on male socioendocrinology because they form multi-male groups in which males are the resident sex. They therefore provide an interesting contrast with other species such as baboons, where females are philopatric.

Much of the endocrine data we have come from captive animals, and we sorely need comparative data on hormone levels of individuals living in natural environments. I collected urine samples from red colobus monkeys in the Kibale National Park, Uganda in an attempt to add to this growing body of knowledge.

I present data on both urinary testosterone level and dominance relationships for eight adult red colobus males living in a single group at Kibale. Urine samples ($N=34$) were obtained opportunistically and dried on filter paper according to a recently developed method. Dominance was determined on the basis of supplants and ritualized dominance presents during *ad-lib* behavioral observations ($N=22$ out of 248 total *ad-lib*s).

Males could not be ranked in a linear hierarchy, and were instead grouped into three dominance tiers. Male urinary testosterone averaged 283 Pmol/Mg Cr (SD 40). Males did not differ significantly in testosterone level, nor was testosterone correlated with dominance. These results suggest that in the absence of a strict linear hierarchy, differences between males in testosterone level may be masked by diurnal variation and/or short term changes in this hormone.

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Phylogenetic test of the expensive tissue hypothesis for encephalization in primates. J.L. FISH, Department of Anthropology, C.A. LOCKWOOD, Institute of Human Origins, Arizona State University, Tempe, AZ 85287.

Relatively large brains are one of the distinguishing features of primates. Many adaptive explanations for encephalization in primates have been proposed (e.g., social intelligence, life history, and ecological factors). Others have focused on the mechanism for increases in brain size. This study uses phylogenetic methods to test one of these mechanisms, the expensive tissue hypothesis.

Aiello and Wheeler (1995) proposed the expensive tissue hypothesis as an explanation for encephalization in primates. This hypothesis states that the metabolic requirements of relatively large brains are offset by a corresponding reduction in the size of the gut. A critical aspect of the expensive tissue hypothesis is that a higher quality of diet, as measured by the digestibility and nutritional content of foods, allows for reduction of the gut. Therefore, increases in relative brain size should be related to increases in relative diet quality. This hypothesis is tested here using both non-directional and directional phylogenetic methods.

Data on primate diet, body weight, and absolute brain weight were obtained from the literature. The phylogeny was derived independently by Purvis (1995). A value for diet quality was created based upon the percentage of high quality foods (i.e., fruit and animal products) in the diet. Diet quality and brain size were adjusted for body size effects by using residuals from the regression of these values against body mass (log transformed). For the independent contrast analysis, both traits were treated as continuous. This analysis showed that an increase in relative diet quality is significantly correlated with an increase in relative brain size ($r=.60$, $p<0.001$). For the directional analysis, relative diet quality was treated as a multistate discrete trait. This analysis revealed that transitions to increased relative brain size generally occur when predicted based on increases in diet quality (sign test, $p<0.01$). Therefore, phylogenetic methods provide strong support for the expensive tissue hypothesis.

Patterns of habitat use for the mantled howler monkey, *Alouatta palliata*, on Isla Colon, Bocas del Toro Province, Panama. K.D. FISH, University of Colorado, Boulder CO 80309, E.P. RILEY, University of Georgia, Athens, GA. 30603, and M.L. SAUTHER, University of Colorado, Boulder CO

While primate group size and distribution responds to various environmental factors, it is still not clear why primates choose certain habitats over others. During an eight week period, we measured various habitat characteristics in order to ascertain patterns of habitat use for the mantled howler monkey, *Alouatta palliata*, in the region of Isla Colon, Panama. We characterized five rainforest habitats in terms of both structure and phenology. Four of these habitats were located on Isla Colon, Bocas del Toro province which is situated off the northwestern coast of Panama. The fifth habitat

occurred on the mainland, three miles west of the island. Habitats included mature forest with minimal and intermediate logging, heavily logged forest in the process of regeneration, mature forest with continual destruction by cows, and mature forests on seasonally flooded soils. For each habitat we measured phenology and structure at 10 meter intervals for a total of 300 meters per habitat. We then did four census walks per habitat during which all encounters with primates were noted. Group size was counted when possible. Results indicate that patterns of leaf production and fruit availability are important; forests with some fruit production as well as constant as opposed to variable leaf production were favored. Group size and frequency of encounters were also greater in such forests. The most heavily logged forest showed no evidence of primate communities even though it has been regenerating for five years and even though corridors to larger intact forests exist. This habitat did exhibit young leaf production, but the structure of the forest was unlikely suitable for primate populations. Although average tree size was similar to that seen in all but the seasonally flooded forest, these trees were widely distributed, showed less connectedness and little fruit productivity. Howlers do, however, show considerable flexibility in reaching remote but productive, intact forests, even travelling short distances on the ground to reach these. Our results indicate that environmental characteristics can be helpful in explaining primate distribution.

Reassessing the Hominoid Vermiform Appendix. R.E. FISHER, Department of Anthropology, Yale University, New Haven, CT 06520

The presence of a vermiform appendix is often cited as a synapomorphy uniting the hominoids. However, appendix-like structures have been reported for many other primate taxa. A review of the literature reveals that the confusion arises because several different--and sometimes contradictory--criteria are enlisted to distinguish an appendix. The criteria most frequently used to define this structure are gross shape and histology (e.g. presence of lymphatic tissue). Unfortunately, descriptions of shape suffer from a lack of quantification, while histological thin sections have not been studied for most primate genera. In addition, studies clearly demonstrate that the concentration of lymphatic tissue in the human appendix varies greatly with age (Williams 1994). Despite this, the ages of specimens are rarely reported in the literature.

Given these complications, the present study seeks to reassess the standards used to designate the presence of an appendix among the primates. In particular, the discussion will focus on proposed taxonomic distributions of the

appendix and the definitions adopted by various anatomists. If soft-tissue traits are to be used in systematics, rigorous character definitions should precede, not follow, their incorporation into phylogenetic studies. Based on anatomical dissections and an extensive literature review, this study will propose a more precise definition of the appendix for use in future phylogenetic studies.

The timing of childhood stress events in an archaeological population of Rome determined using enamel microstructural analysis. C FITZGERALD¹, SR SAUNDERS¹, R MACCHIARELLI², and L BONDIOLO², ¹Dept of Anthropology, McMaster University, Canada, and ²National Prehistoric Ethnographic "L. Pigorini" Museum, Rome, Italy.

Enamel hypoplasia and histological indicators of physiological perturbations known as Wilson bands have played a major role in bioarchaeological analyses, yet their full potential as analytical tools has not been achieved because of the inaccuracy of current methods of determining the ages at which they developed. Furthermore, there are debates concerning the interpretation of hypoplasias of various widths and depths and how these may relate to the length and severity of the physiological stress that produced them that can only be resolved with methods that can precisely determine the timing of dental growth (Goodman and Rose, 1990).

This paper reports on a study that uses enamel microstructures to determine the chronology of Wilson Bands in a sample of deciduous teeth from the inhabitants of Portus Romae (the necropolis of Isola Sacra, II-III cent. AD). The technique interprets growth markers, striae of Retzius and cross striations, which permits precise timing to be established. Since it uses information endogenous to the tooth itself rather than relying on assumptions like linearity of crown growth, or on statistical formulae derived from small samples, it overcomes many of the problems that have led to questions about the veracity of conventional methods. Sections of 273 different deciduous teeth from 131 individuals were examined and those with Wilson bands, whose microstructures were clearly visible, were analysed. Timings of stress events were calculated in relation to the neonatal line, permitting absolute chronologies to be determined.

The excellent correlation of timings observed between coeval stress events in individuals with multiple teeth reinforces the consistency and effectiveness of the microstructural approach.

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Alternative demographic models for the colonization of the Americas. A.G. FIX, Department of Anthropology, University of California, Riverside, CA 92521.

The mode and tempo of colonization of the Americas established the initial pattern of continental genetic diversity. Despite a long history of study, the process of settlement remains controversial in terms of date, rate, and pattern.

One classic model, based on Birdsell's argument that human populations are able to multiply rapidly, postulated a wave of expansion across the land masses of North and South America. An alternative model limited the initial colonization to the coasts with later spread along rivers to the interior of the continents. Range expansion along this linear habitat from North to South America could be very rapid without requiring population saturation of entire continental regions.

The aim of this paper is to evaluate these alternative models in terms of the demography of colonization based on the evidence of population structures, mobilities, and demographic histories from recent well-known small-scale human populations.

These models have somewhat different implications for genetic variation. As Cavalli-Sforza has noted, the Birdsellian model would have generated extreme heterogeneity among the initial population (F_{ST} after 1000 years of budding and expansion of 0.855). Computer simulations testing various demographic parameter values for the two models show that the coastal migration route avoids some of the extreme demographic and genetic effects of the continental model.

The phylogenetic implications of the early ontogeny of craniofacial growth and development in colobines using 3-D image analysis. C. W. FLATTMANN, Department of Anthropology, New York University, New York, NY 10003.

Colobine evolutionary history has been examined in terms of behavioral, morphological, anatomical and molecular traits. Prior studies, including that of Strasser and Delson (1987), have reconstructed the phylogeny of colobines primarily based on traits of adult forms. Juvenile traits have been considered superficially, in terms of Pocock's classification of neonatal coat color, or indirectly, in parenting behaviors such as infant carrying and aunting behaviors.

The goal of this study is to examine phylogenetically informative morphological characters based on growth and development of the face and cranium in colobines. The inclusion of juvenile stages of male and female morphologies may facilitate the reconstruction of

inferences about polarities of traits. Taxa were selected to allow measurement of morphological distance between the African and Asian colobine lineages.

Data were collected in a relative growth series in the African genus *Procolobus* (*P. (Piliocolobus) badius*, N=69), the Asian genus *Nasalis* (*N. larvatus*, N=38, and *N. (Simias) concolor*, N=16), and a cercopithecine outgroup, *Macaca* (*M. fascicularis*, N=78). A set of skeletal landmarks of the face and neurocranium were collected using a 3-D digitizer. Specimens were assigned to age cohorts based on dental eruption stage. Landmarks were grouped to describe craniofacial shape in the sagittal, coronal, and transverse planes. The mean configuration for each planar view was calculated for each age-sex cohort. Spline comparisons were made using Age's GRF-ND and Morpheus programs.

The results of this analysis show that taxon-specific eye orbit morphology, zygomatic orientation, mid-face height and dental arcade position are diagnostic even in early stages of ontogeny. *Nasalis* and *N. (Simias)* juvenile stages were markedly more distinct than their inclusion in the same genus would suggest.

Comparing the shape of primate behavior and ecology. J.G. FLEAGLE, Department of Anatomical Sciences, SUNY at Stony Brook, Stony Brook, NY 11794-8081 and K.E. REED, Institute of Human Origins, Department of Anthropology, Arizona State University, Tempe, AZ 85287

One of Charles Oxnard's many innovations in the study of biological anthropology was his pioneering effort to quantify aspects of primate behavior and ecology for major radiations and to compare the shapes of these behaviors through multivariate analysis. In a series of studies with Robin Crompton and Susan Lieberman, he compared the shape of prosimian lifestyles with similar analyses of morphological measurements in these same taxa. One unexpected result was that multivariate analysis of quantified adaptive features of primate behavior and ecology tends to cluster primates into phylogenetic groups.

In a series of studies of primate communities using quantitative field data on aspects of primate locomotion, diet and activity pattern, we have found a similar result - that phylogenetic groups are usually characterized by common features of behavior and ecology. However, the relationship between adaptation and phylogeny in quantitative features of primate behavior and ecology is a complex one, both with and between adaptive radiations. Part of this complexity comes from some instances of taxa that have conserved primitive adaptations for millions of years, and other instances of adaptive parallelism or convergence in separate lineages.

As Charles Oxnard has emphasized in his remarkably creative career of morphometric and ecological studies over the past forty years, most biological data contain insights into both adaptation and phylogeny if one takes the time to examine them through a number of different perspectives.

Evolution of the frontal trigon in primates. S.M. FORD and W.D. MOORE, Southern Illinois University, Carbondale, IL 62901-4502.

The frontal trigon in combination with superorbital ridges (supraorbital costae) is found in a number of fossil catarrhines and has been used as a phylogenetic character by many researchers. The discovery of the face and skull of *Victoriapithecus*, which exhibit these features, led Benefit and McCrossin (1991, 1993, 1997) to argue persuasively that these features characterized the catarrhine common ancestor, a complex lost in most late Miocene and extant catarrhines.

This study explores the distribution of the key components of this "catarrhine" complex in other primates, particularly fossil forms, to determine the likelihood that it represents either a synapomorphy or symplesiomorphy of early catarrhines. The presence/absence of four key components of the "catarrhine" complex were scored: 1) superorbital ridge; 2) lack of a post-glabellar depression; 3) initiation of convergence of temporal lines closely behind the orbits; and 4) complete convergence of temporal lines before or around the coronal suture. The latter two traits together comprise what has been called the "frontal trigon".

Survey of primate skulls shows that two of the four components are widespread in adapids, omomyids, early anthropoids, and Malagasy subfossil lemurs, as well as many living galagines and lemuroids: little to no post-glabellar depression and initial convergence of the temporal lines close to the orbits. A third component, complete convergence of the temporal lines near the coronal suture, is nearly as widespread, although some (particularly among the omomyids) converge slightly farther back on the parietals or not at all. However, most features of the "catarrhine" complex are absent in fossil and living lorises, fossil and living platyrrhines, as well as some omomyids and *Tarsius*.

This distribution does not present a precise and clear argument for any single interpretation of polarity. However, the preponderance of data from fossil primate skulls, in particular, argues that accentuation of the anterior portions of the temporalis musculature, resulting in a combination of anterior initial convergence and (usually) frontal complete convergence of the temporal lines (the presence of a "frontal trigon" or "frontal diamond"), is the ancestral condition for primates. In conjunction with this would occur a fairly smooth frontal, or lack of a post-glabellar depression. This polarity then suggests the loss of a "frontal trigon" or "diamond" as independent synapomorphies of lorises, of platyrrhines, and of several lineages of catarrhines evolving in the late Miocene or later. The development of supraorbital costae or ridges appears as a synapomorphy of early catarrhines.

Stature as an indicator of life conditions in Upper Paleolithic and Mesolithic Europe. V. FORMICOLA, Dept. di Etologia, Ecologia ed Evoluzione, University of Pisa, 56126 Pisa, Italy.

The Later Pleistocene- Early Holocene transition in Europe is marked by dramatic changes in climatic and environmental conditions that resulted in shift in resources, subsistence strategies, and lifestyle. Associated phenomena are diversification in foraging technology, changes in settlement patterns, population increase, and a broad range of biological adaptations recorded in bones and teeth.

Stature, as an indicator sensitive to environmental and

socio-cultural variables, can provide clues into life conditions and microevolutionary trends affecting Upper Paleolithic and Mesolithic populations. Viewed in this light, the very tall stature shown by Upper Paleolithic groups living in Europe before the Last Glacial Maximum points to high nutritional standards as the most important factor.

Lower protein intake, together with inbreeding effects, may account for the marked decline of stature after the Last Glacial Maximum, a very dynamic phase from an evolutionary point of view. In particular, the negative trend affecting Western European populations after the Last Glacial Maximum suggests that changes in faunal composition, population packing, and intensified exploitation of resources had important effects on life conditions and on the quality of diet. Moreover it is likely that the increased territorialism characterizing Late Upper Paleolithic and Mesolithic groups resulted in relative isolation, restriction of mating networks, and, consequently, in decreased gene flow.

Analysis of regional differentiation of stature, particularly well supported by data from Mesolithic sites, shows absence of differences among samples widely distributed from Scandinavia to the Mediterranean basin, and suggests a relative homogeneity in nutritional and biodemographic patterns for the last hunter-gatherer populations of Western Europe.

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Temporal trends in mission populations: a comparison of pathological frequencies and long bone length at mission San Juan de Capistrano. J.R. FRANCIS, Center for Archaeological Research, University of Texas at San Antonio.

Previous studies of mission populations have suggested that the effects of European contact had a deleterious effect on the health of indigenous populations. The goal of this research is to determine if the health of the mission Indian population changed during the period of secularization at Mission San Juan de Capistrano.

Secularization was a period of rapid sociopolitical change and socioeconomic collapse that brought about the end of the Spanish Colonial period in Texas. Stress due to European contact could have limited the ability of the mission Indian population to respond to additional stress brought about by secularization. Demographic changes during secularization would tend to highlight differences in health between the mission Indian population during the Colonial period and the Hispanic population of the post-Colonial period.

The frequency of pathological conditions such as porotic hyperostosis and linear enamel hypoplasia, as well as long bone length are used to examine differences in health between two populations at Mission San Juan. The populations are represented by two burial groups whose internment spans the Colonial and post-Colonial period.

Cross-sectional metric analysis of scapular axillary border morphology in recent humans and the Krapina Neandertals. R.G. FRANCISCUS and C.R. SCHOENEBAUM, The University of Iowa, Iowa City, IA 52242

The high frequency of dorsal sulci on the scapular axillary borders (SAB) of Neandertals is well documented. Analyses to date have found weak associations between *non-metric* SAB patterning and aspects of upper limb size and robusticity. This has suggested a non-functional, genetic basis for SAB trait manifestation.

We explored SAB variation using *metric* measurements of SAB total width, and ratios of ventral/dorsal sulcal width to SAB width in recent humans (Euro-Americans, n=55; African-Americans, n=60) randomized from a larger sample (n= 580 males) ranging from extreme ventral to extreme dorsal SAB patterning. Eleven Krapina Neandertal scapulae were also measured. Measurements were taken to 0.05 mm accuracy from SAB molded cross-sections. Right and left SAB sections were taken at mid-axillary border, circumflex artery impression, and just inferior to the infraglenoid tubercle position. All molds were taken on originals and standardized in 3-D space. For the recent samples we also collected standard scapular, humeral, and clavicular measures reflecting shoulder size, robusticity, muscularity and chest shape.

Univariate and multivariate modeling indicates a significant positive response in total SAB width to overall shoulder/chest size, particularly in response to humeral circumference and scapular glenoid fossa height (right sides multiple $r = 0.49$). In contrast, the range of ventral to dorsal sulcal width was not significantly associated with overall shoulder/chest size, but showed a range of relatively weak correlations with individual measures of upper body muscularity, robusticity and shape. The highest of these was an inverse relationship in dorsal sulcal width with standardized humeral deltoid tuberosity width ($r = -0.25$). The Krapina mean dorsal sulcal width standardized to SAB width, while absolutely greater, was not statistically significantly different from the recent samples at $\alpha = 0.05$. Overall, the explained variation in metric measures of scapular axillary border patterning (other than total SAB width) as a result of biomechanical/functional factors is low, lending additional credence to the notion of a genetic basis for trait patterning, albeit one that is likely polygenic.

Population structure in late Pleistocene and recent Europeans. D.W. FRAYER, Department of Anthropology, University of Kansas, Lawrence, KS 66045, J. HAWKS, Department of Anthropology, University of Utah, Salt Lake City, UT 84112 and R. CASPARI, Paleoanthropology Laboratory, Department of Anthropology, University of Michigan, Ann Arbor, MI 48109.

One of the most interesting attributes of recent human populations is their population structure. Fst values reported for human populations are quite low indicating minimal amounts of between group genetic variation relative to the total genetic variation. Low Fst has been documented for

regional groups and even lower values have been calculated for populations within regions. Because it measures gene flow, the timing of the emergence in this unusual population structure has important implications for many ongoing discussions regarding the social behavior of prehistoric humans and the meaning of modernity.

Relethford showed that F_{st} can be estimated from craniometric data; his results based on osteological variables were comparable to those based on genetic data and he concluded that craniometric data could be used as proxies for genes in some analyses. Using his technique, we found that dental breadths also yield a comparable F_{st} estimate for living humans. Our pilot study using the dentitions of Middle Paleolithic, Upper Paleolithic and Neolithic populations demonstrated lower F_{st} values in the Paleolithic, with increased F_{st} in the Neolithic populations. One explanation for this pattern is the shift from hunting/gathering to more sedentary subsistence patterns of the Neolithic, when, as some suggest, mates were found more locally and marriages were more strictly prescribed.

In the current study we assess this explanation by comparing F_{st} in three European craniofacial and dental samples: Upper Paleolithic, Mesolithic and Neolithic. Each of these samples are subdivided into three geographic populations, Western, Eastern, and Northern European and the relationship of between group variance to the total variance is assessed. Results indicate that an increase in F_{st} is associated with the Neolithic and is likely to be a consequence of sedentism and a more "tribal" social structure.

The variable evolution of pairbonds in human and nonhuman Primates. A. FUENTES, Dept. of Anthropology, Central Washington University, Ellensburg WA 98926

Pairbonding may be a significant feature of the social repertoire in a number of primate species. However, inter- and intraspecific examination of pairbonds is currently problematic for two reasons. The first is a lack of a concrete definition of the "pairbond". The second is an assumption that social relationships in two-adult grouped primates are "pairbonds" in the same manner as those in multimale/multifemale species and are thus best explained by invoking similar evolutionary scenarios.

I propose that two types of pairbond (social pairbond and sexual pairbond) occur and can be defined and described in such a manner that facilitates comparative analysis across primate taxa. This comparative analysis is critical for any investigation into the evolution of primate social behavior.

Here I report on aspects of behavior and ecology in both two-adult and multimale/multifemale grouped primates. Behavioral and ecological data from a number of primate taxa suggest that different evolutionary pathways may be posited to explain grouping patterns and pairbonds and that the two need not be one and the same.

The evolution of grouping pattern in many two-adult

grouped primates (*Avahi*, *Callicebus*, *Indri* and *Hylobates* in this case) may be best modeled using evolutionary scenarios relying on direct dietary/energetic constraints, predation and possibly mate-guarding. These selection pressures are also probable factors in the evolution of predictable male-female dyads in the multimale/multifemale grouped *Eulemur*. The evolution of pairbonds in the multimale/multifemale grouped *Homo* is most likely related to generalized anthropoid trends in social alliance formation coupled with increasing social complexity as well as specific ecological variables. Little support was found for both the infanticide prevention and paternal provisioning models.

The effect of maternal UVB radiation deprivation on pregnancy and parturition. K. FULLER, University of Kansas School of Medicine, Kansas City, KS 66160.

Between 1880 and 1940, African Americans experienced a dramatic decline in fertility, which rebounded in the decades following 1940. By 1890, two-thirds of the African Americans living in the North and West were urbanites. Therefore, any analysis of the fertility decline must focus special attention on northern, urban populations. One possible contributory factor which has received little or no attention is inadequate exposure to ultraviolet B (UVB) radiation, a problem of particular concern to heavily-pigmented populations, since inadequate UVB radiation results directly in inadequate levels of serum vitamin D, leading to bone mineralization and growth problems, including inadequate pelvic growth.

Because inadequate growth in the pelvis can result in problems later in life during parturition, female pelvic skeletal material from the Hamann-Todd collection (Cleveland Museum of Natural History), which dates to the time period in question, was studied. The pelvic material of 77 black (heavily-pigmented, based on cadaver photos) women was compared to that of 43 white (lightly-pigmented, based on cadaver photos) women. Analysis of pelvic measurements revealed that the posterior portion of the pelvic inlet was significantly smaller in the heavily-pigmented women; a result to be expected if a woman had experienced inadequate levels of vitamin D during infancy. There were no significant differences in stature or body mass between the two groups, therefore differences in nutrition can be ruled out as causing differences in pelvic capacity. Furthermore, nutrition plays little, if any, role in maintaining appropriate vitamin D levels since only some fatty, oily fish (e.g. cod) have naturally-occurring high levels of vitamin D. UVB radiation/vitamin D deprivation and its effects on bone mineralization and growth were not elucidated until the 1920s and it was not until 1940 that foods were fortified with vitamin D. Therefore, based on an analysis of skeletal material from the period between 1880 and 1940, it can be postulated that one of the causes of the African-American fertility decline of that same period was maternal UVB radiation deprivation resulting in difficulties during pregnancy and parturition.

DNA sequence variation at the *APOE* locus: new insights into the global distribution of an important human polymorphism. S. M. FULLERTON¹, K. M. WEISS¹, A. G. CLARK¹, S. L. TAYLOR², D. A. NICKERSON², J. STENGÅRD³, E. BOERWINKLE⁴, and C. F. SING⁵.

¹Depts of Anthropology and Biology, Penn State University, ²Dept of Molecular Biotechnology, University of Washington, ³National Public Health Institute, Dept of Epidemiology and Health Promotion, Helsinki, Finland, ⁴Human Genetics Center, University of Texas Health Science Center, and ⁵Dept of Human Genetics, University of Michigan Medical School.

A good deal is known about the global distribution of apolipoprotein E protein variants and their relationship to cardiovascular and Alzheimer's disease risk. However, allelic variation underlying the observed polymorphism is only incompletely characterized. We investigated DNA sequence variation at the *APOE* locus in 96 individuals drawn from 4 populations (African-Americans from Jackson, MS, non-Hispanic whites from Rochester, MN, Finns from North Karelia, Finland, and Mayans from Campeche, Mexico). Within the 5.5 kb region surveyed we identified a total of 23 variable sites (22 SNPs and 1 indel), including the two nonsynonymous SNPs that define the classic $\epsilon 2$, $\epsilon 3$, and $\epsilon 4$ protein alleles. The observed sites segregate as 26 sequence haplotypes and comprise 4 groups of related haplotypes: an $\epsilon 2$ clade, an $\epsilon 4$ clade, and a pair of divergent $\epsilon 3$ clades. The root haplotype, identified via human-chimpanzee sequence comparison, falls in the $\epsilon 4$ clade, suggesting that the $\epsilon 4$ allele is ancestral to the other major alleles at this locus. Interestingly, this allele (which makes up only 13.5% of the chromosomes surveyed here) is the one associated with elevated lipid levels and Alzheimer's Disease risk. The most common allelic class, $\epsilon 3$ (79.7%), is derived from the $\epsilon 4$ clade and is split into two major lineages, from one of which the $\epsilon 2$ alleles (6.8%) derive. Both the pattern of allelic divergence and the low overall level of variation at the sequence level suggest the influence of natural selection on the observed polymorphism.

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Perspectives on the Genetics of Aging: An Introduction. TB. GAGE, Departments of Anthropology and Epidemiology, University at Albany, Albany NY 12222.

There is increasing interest in the genetics of aging and the life span. The purpose of this symposium is to present a variety of research perspectives concerning the genetics of aging and longevity. The topics considered include areas of traditional interest within biological anthropology, as well as, perspectives from several other disciplines.

The areas covered include, 1) sampling and the methodological issues of collecting information on the genetics of aging 2) theoretical issues concerning the evolutionary and genetic contributions to human

senescence, 3) the genetic mechanisms of reproductive aging, 4) the genetic contribution to a variety of degenerative diseases, and 5) the genetic contribution to overall longevity. In addition to biological anthropology, the speakers represent ecology, epidemiology, human genetics, and demography. Among the areas considered, the direct genetic contribution to life span is only beginning to be researched within biological anthropology.

A representative of the National Institute of Aging will also discuss NIA's initiatives concerning the genetics of aging and the mechanisms for funding research in this area.

The trabecular structure of the South African australopithecine pelvic bone : a question of angles?

V. GALICHON, Collège de France, Paris, France.

It has recently been demonstrated that the trabecular structures of the pelvis of South African australopithecines are well preserved (Macchiarelli, Bondioli, Tobias, Galichon, 1998). CT scans and conventional X-ray images show human-like features over the acetabulum, including the crossing of trabecular bundles giving stability to the hip of Plio-Pleistocene hominids. Among the questions still to be addressed concern angles associated with the chiasma measured from the crossing of trabecular structures. Is the observed range of variation in these angles due to the differences in age and sex within a species, or differences between species? In what manner are the observed differences in pelvic morphology associated with locomotor adaptations? To what extent are the observed differences associated with processes of fossilisation? These questions are discussed in the context of CT scans and conventional X-rays.

Forensic impact injuries in skeletal material. A. GALLOWAY, Dept. of Anthropology, University of California, Santa Cruz and R. T. MASON, Santa Cruz County Sheriff-Coroner's Office, Santa Cruz, CA

Forensic anthropologists often are confronted with skeletal material in which the context of injury and death is lost - due to deliberate dissociation, taphonomic processes or accidental circumstances. Recognizing individual defects on the skeletal material and the mechanism of injury which could produce each is the first step in trauma analysis. Beyond this, the pattern of injuries may reflect the circumstances in which the decedent was involved. When context is lost, interpretation of this pattern may be the primary clue as how and where the person died.

While hospital records document patterns of injury attributable to specific causes, these usually represent all injured parties - from those suffering only minor trauma to those dead on arrival. Forensic anthropologists, in most cases, are concerned with cases in which injuries lead to

death and, for this reason, a forensic sample is more appropriate as a basis for interpretation.

In this retrospective study, over 80 cases of impact injury were examined from 1994-1997. In each case, the victim died and the body was sent for forensic autopsy. All major skeletal injuries were noted. The manner of death was either accidental or suicide; homicidal blunt force trauma was not included in this study. The majority were due to motor vehicle accidents or falls from height. Cause of death was listed as being attributable to impact, usually on the head or chest. Nine percent of the victims died without any skeletal trauma. In about half of these cases the individual was elderly (over 75 yrs). Of the remaining victims, 60% suffered single or multiple injuries to the skull and 49% suffered rib fractures. Other skeletal injuries reported include those to the femur (18%), clavicle (17%), pelvis (16%), tibia (14%), thoracic spine (11%), and humerus (10%).

The pattern of these injuries reveal circumstances in which they were inflicted. Factors which influence the pattern include the mode of injury, position and age of the victim and the forces responsible.

Brain language area evolution: Human-like pattern of cytoarchitectonic, but not gross anatomic, L>R hemispheric asymmetry of planum temporale homolog in *Macaca fascicularis*. PJ GANNON^{1,2,3,4,5} PR HOF^{2,3,4} and NM KHECK¹. Depts ¹Otolaryngology, ²Neurobiology & ³School of Biomedical Sciences, Mount Sinai School of Medicine, New York, NY 10029; ⁴New York Consortium of Evolutionary Primatology; ⁵Dept Anthropology, NY Univ.

Recently, left hemisphere predominance of the homolog of a key human brain language area, the planum temporale (PT), was demonstrated in chimpanzees and other great apes (Gannon et al., *Science*, 279:220-22, 1998; *Soc. Neurosci.* 64:15, 1998). In this study, we determined whether similar asymmetries were present in the PT homolog, Area Tpt, of a representative cercopithecoid species *Macaca fascicularis*.

Two discrete methods were used to assess and compare Tpt magnitude on the L&R hemispheres of macaques: a) an indicative morphometric linear measure, sylvian fissure length (SF-l) and b) stereologic volumetric estimates of Area Tpt's distinct cytoarchitecture (Tpt-v) using the Cavalieri method. SF-l was measured on the L&R hemispheres of 18 ♂ and 16 ♀ perfusion-fixed brains with braided silk sutures that were straightened and lengths determined with calipers. In 6 brains, 40µm coronal sections were prepared from the portion of the L&R superior temporal gyri posterior to the central sulcus, and Nissl stained. Every 10th section was used for stereologic analysis of Tpt cytoarchitectonic volume. Statistical tests of analysis of variance, paired t-tests and coefficients of variance and error (CV & CE) were used to indicate the distribution and significance of hemispheric asymmetries.

Unlike humans and great apes and in contrast to previous reports in OW monkeys, no significant differences between SF-l on the L&R hemispheres ($p=0.49$ total sample; $p=0.38$ ♀, $p=0.82$ ♂) were evident. In contrast, Tpt-v was significantly

($p<0.01$) larger ($26\pm5\%$) L>R in 5 brains (83%) while in the sixth, L=R. Low CV (L=0.08, R=0.1) and CE (L=0.04, R=0.04) indicated a stable representation of Tpt asymmetry.

This study demonstrated that marked, human-like L>R cytoarchitectonic volumetric asymmetries are present in this brain language area homolog. Since these pronounced cellular asymmetries are not captured by gross anatomic measures, cortical surface information derived from endocasts is not a reliable indicator. However, we propose that these cerebrocortical areas had a long evolutionary history and are involved with polymodal communication in OW monkeys.

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The behavioral ecology of mixed species troops of *Callimico goeldii*, *Saguinus labiatus*, and *S. fuscicollis* in northwestern Brazil. P.A. GARBER. Department of Anthropology, University of Illinois, Urbana, Illinois 61801.

A small number of primate taxa form polyspecific associations in which groups of two or more species travel and feed together as a single large troop. Although the precise ecological and social factors that permit members of different species to form associations remain unclear, it has been suggested that differences in body size, patterns of habitat utilization, and positional behavior play a primary role in maintaining troop stability. In this study I examine the behavioral ecology of mixed species troops of *Callimico goeldii*, *Saguinus labiatus*, and *Saguinus fuscicollis*, and focus on similarities and differences in the manner in which groups of each species exploit a common home range.

Information on habitat utilization, positional behavior, substrate preference, and patterns of interspecific association were collected from February through May, 1999 on mixed species troops of Goeldi's monkeys, red-bellied tamarins, and saddle-back tamarins inhabiting Fazenda Experimental Catuaba, a 820 ha forest reserve administered by the Universidade Federal do Acre in northwestern Brazil (10°4' S, 67°37' W). Individuals in each group were trapped and fitted with either a radio collar or a beaded identification collar. Data collected represent 185 hours of quantitative observations using a 2-minute instantaneous focal animal point sampling technique and radiotracking.

The results indicate that although the same labiatus-fuscicollis troop was in association in over 60% of sightings, a single *Callimico* group formed temporary associations with as many as 4 different tamarin troops. Moreover, whereas *Callimico* was observed to forage and refuge under tree falls and in areas of dense bamboo, the tamarins were most frequently found to exploit secondary and edge habitats. Patterns of positional behavior also varied between species, with *Callimico* spending 40% of travel on trunks compared to 25% in *S. fuscicollis*, and 9% in *S. labiatus*. In all 3 species, leaping accounted for between 30-35% of the positional repertoire. In *Callimico*, however, over 55% of leaps were from trunk-to-trunk. In *S. fuscicollis* 24% of leaps were trunk-to-trunk and in *S. labiatus* only 4%. Additional relationships between patterns of habitat utilization, positional behavior, and species differences in leading troop progression are discussed.

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